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(54) **DEVICE FOR FILTERING THE INTAKE AIR OF INTERNAL COMBUSTION ENGINES**

VORRICHTUNG ZUM FILTRIEREN DER ANSAUGLUFT VON BRENNKRAFTMASCHINEN

DISPOSITIFS DE FILTRAGE DE L'AIR D'ADMISSION DE MOTEURS A COMBUSTION INTERNE

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US-A- 5 685 887 **US-A- 5 688 299**

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Description

TECHNICAL FIELD

[0001] The present invention relates to filters for filtering the intake air of internal combustion engines. Essentially the invention refers to filters for the intake air of supercharged and aspirated internal combustion engines, particularly of the type used in the races. Document US 5,685,887 discloses a filter element comprising a filter material having corrugated sectional surface formed in the shape of a cylindrical housing. An upper portion of the cylindrical housing is kept closed, and a lower opening portion is connected to an air suction duct. The upper and lower portions of the cylindrical housing are respectively fixed to a support ring edge member and a ring shaped connecting member of synthetic rubber. The main drawback of said filter element consists in that the ring edge and connecting members are heavy, expensive and not resistant to temperatures higher than the vulcanization temperature of the synthetic rubber.

A further drawback consists in that said connecting member of the filter element can be fixed only externally to an apposite connector of the suction duct.

[0002] Document US 5,688,299 discloses an air filter including a base member oval or circular flange shaped, internally provided with fixing screw for the connection to an adequate and specific support. The main drawback of said latter filter consists in that it can be assembled only externally to said specific support.

A further drawback of the known filters consists in that the filtering elements have form and dimensions preset by the characteristics of the relative container or connector and therefore not adjustable.

[0003] The known filters for the use in sporting engines, the usually called "sprint filter", have polyester filtering elements, whose ends have heavy polyurethane flanges and/or caps that are extremely expensive and further cannot withstand temperatures greater than 90° C, because of the used material. These filters are generally truncated cone shaped and they are enclosed in metallic containers shaped as almost conic or truncated-conic portions.

The known filters with the paper filtering elements guarantee a good filtration, because they hold particles bigger than 10 µm, but they have the drawback of an excessive flow resistance for the airflow passing through.

[0004] Another drawback of the latter known filters consists in the insufficient filtering surface, due to the conic shape of the filter having wide inclination angles.

DISCLOSURE OF THE INVENTION

[0005] The main object of the present invention is to propose a filter for the intake air of internal combustion engines that does not require a special case or container but that is assembled on the expansion box of the intake

collector.

[0006] A further object of the present invention is to propose a visible and checkable filter from the outside and with an easy and fast assembling and disassembling outside and inside of the expansion box.

[0007] A further object is to propose a filter with adjustable geometric features without modifying the fixing or housing means.

[0008] A further object is to propose a light filter but at the same time solid, stiff and resistant to temperatures higher than 200 C°.

[0009] Other object is to propose a filter with a large surface of the filtering elements and low flow resistances of the filtered air.

[0010] Further object is to propose a filtering device reliable having a life for a route not less than 150.000 km, however usable with a very low maintenance and easy to dispose because principally made of a natural material.

[0011] The main object of the invention is achieved with a device according to claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The characteristics of the invention are underlined in the following with particular reference to the attached drawings, in which:

- figure 1 shows a perspective view of the filter in an assembled condition in the engine;
- figure 2 shows an enlarged longitudinal section view of the filter of figure 1;
- figure 3 shows a top view of the filter of figure 2;
- figure 4 shows a plant view of supporting means of the filter of figure 2;
- figure 5 shows a section view according to the plain V-V of the supporting means of the figure 4;
- figure 6 shows a section view of two variant of the filter of figure 1 in correspondence of the assembling condition;
- figure 7 shows a section view of the filter of figure 6 in correspondence of a variant of the assembling condition.

BEST MODE OF CARRYING OUT THE INVENTION

[0013] With reference to the figures from 1 to 7, numeral 10 indicates a filter for the intake air of internal combustion engines, numeral 100 indicates an intake collector of the air and numeral 110 indicates an expansion box of the internal combustion engine.

[0014] The filter 10 includes a first filtering tubular element 2, a second filtering element 3, an upper annular element 1 and supporting means 4.

[0015] The first filtering elements 2 are tubular shaped, for instance cylindrical or truncated-conical shaped with round or oval or elliptical cross sections, delimited by an upper and a lower end.

[0016] The second filtering elements 3 are substantially flat with a circular or oval or elliptical shape.

[0017] The first filtering elements 2 have angular or undulated beads in order to stiffen the structure and to increase the surface development.

[0018] Both the filtering elements, first 2 and second 3, are made by interposing between two layers of metallic net, for instance made of aluminum, a plurality, for instance four, of layers of fabric or felt in natural cotton soaked with low viscosity oil, before assembling the filter 10.

[0019] The upper element 1 consists in a circular or elliptical or oval flange having a "L" shaped section whose inside angle carry out an upper annular housing 8 to which the upper ends of the first filtering elements 2 and the external edge of the second filtering elements 3 are fixed.

[0020] The supporting means 4 include a lower annular housing 9, circular or oval or elliptical shaped, to which the lower end of the first filtering elements 2 is fixed.

[0021] Furthermore, the supporting means 4 have, a central circular hole 5 and an elliptical shaped flat flange 7 with a plurality, for instance three, of external holes 6 for assembling the filter 10.

[0022] It is also provided that the upper element 1 and the supporting means 4 are made in composite material with synthetic matrix strengthened with carbon fibers.

[0023] Furthermore the fixing of the first filtering elements 2 to the annular housings, upper 8 and lower 9, and the fixing of the second filtering means 3 to the upper annular housing 8 is made by gluing with bi-component synthetic resins, for instance epoxidic or polyurethanic.

[0024] The collector 100 substantially consists in a duct, for instance a wrinkled flexible or rigid hose, whose ends are connected and in flow communication with the supply elements of the internal combustion engine and with the expansion box 110. The expansion box 110 substantially consists in a rigid case, for instance cylindrical shaped with elliptical section or parallelepipedal shaped, having in a flat portion fixing means 13 consisting, for instance, in stud bolts corresponding to the external holes 6 of the flange 7 and nuts or wing nuts. The expansion box 110 has an opening 12 that, in assembling condition M, mates the hole 5 of the flange 7.

[0025] It is further provided a gasket 14 positioned between the flange 7 and the expansion box 110 in order to guarantee the pneumatic seal. Obviously the gasket 14, for instance made of synthetic rubber, has no interference with the fixing means and with the opening 12 of air passage of the expansion box 110. The sealing gasket 14 has also the purpose to share the forces and to uniform the joining pressure between the expansion box 110 and the filter 10 and to reduce the vibrations transmitted to this latter.

[0026] The operation provides that the engine intake air flows initially through the filtering elements first and

second 2,3 which purifies the air from particles and dusts, having dimensions bigger than the filtering capacity of the fabric or oil soaked cotton felt, and in sequence, flows through the expansion box 110 and the collector 100 finally arriving to the supply elements of the internal combustion engine when the air and fuel are mixed.

[0027] It is advantageous to underline that it is possible to mount the filter object of the present invention in external position but also in an assembling condition MM in which the filter 10 is inside to the expansion box 110 of suitable geometric features. Besides, the filter object of the present invention is suitable for fast changes and disposition variations that are valuable features in the races and the prototypes fields.

[0028] There are variants, not shown, in which the flange 7 is approximately circular or polygonal shaped in order to realize the better coupling with the expansion box 110 with respect to the characteristics of this latter.

[0029] Further variants, partially shown in figures 6 and 7, refers to the shape of the second filtering element 2 that has alternatively concave or convex shape, with approximately semi-elliptical section, developed toward the inside or the outside of the filter 10, or with beads having concentric annular parallel development, or with approximately conical shape, developed toward the outside or the inside of the filter 10, having a series of radial beads starting from the cone vertex up to the base in proximity of the upper element 1. The beads have for instance triangular or undulated sections.

[0030] The above-described variants do not modify the operation but increase the filtering useful surface of the filter 10 and/or strengthen this latter.

[0031] The main advantage of the present invention is to provide filters that do not need a particular container but can be mounted on an expansion box of the intake collector.

[0032] A further advantage consists in that the filters according to the present invention are visible and checkable from the outside and have an easy and quick assembling and disassembling, and have variable and modifiable geometric features without modifying the fixing or housing means.

[0033] Another advantage is to provide single body filters lightweight but at the same time solid, stiff and resistant to temperatures even higher than 200 C°, and filters having a large surface of the filtering elements and low flow resistance of the filtered air.

[0034] A further advantage consists in providing a reliable filter having a life for a route not less than 150.000 km, however usable with a very low maintenance and easy to dispose because primarily made of a natural material.

Claims

1. Device for filtering the intake air of internal combus-

tion engines provided with an expansion box (110) having an opening (12), with a filter (10) including a first filtering tubular element (2) and further including :

- an upper annular element (1) consisting of an annular "L" section flange provided with an upper annular housing (8) in which the upper end of the first filtering element (2) is fixed;
- a second filtering element (3) peripherally fixed to the upper element (1);
- supporting means (4) provided with a lower annular housing (9), in which the lower end of the first filtering element is fixed (2), a central hole (5) in flow communication with the opening (12) in correspondence of an assembling condition M and a flat flange (7) for fixing the expansion box (110).

2. Device according to claim 1 **characterized in that** the supporting means (4) and the upper element (1) are made of composite material with synthetic matrix strengthened with carbon fibers.

3. Device according to claim 1 **characterized in that** the flange (7) is approximately elliptical or circular or polygonal shaped.

4. Device according to claim 1 **characterized in that** the flange (7) has external holes (6) in which arc engaged fixing means (13) of the expansion box (110) in correspondence of said assembling condition M.

5. Device according to any of the preceding claims **characterized in that** the second filtering element (3) is flat and approximately circular shaped.

6. Device according to any of the preceding claims **characterized in that** the second filtering element (3) is concave or convex with semi-elliptical section.

7. Device according to any claims from 1 to 4 **characterized in that** the second filtering element (3) has a series of beads fit to increase the filtering surface and stiffness.

8. Device according to claim 7 **characterized in that** the beads are annular and concentric.

9. Device according to any claims from 1 to 4 **characterized in that** the second filtering element (3) is approximately conical shaped and has a series of beads along its generating lines.

10. Device according to any of the preceding claims **characterized in that** the filtering elements first (2) and second (3) consist of a plurality of cotton layers,

soaked of low viscosity oil, interposed between net elements.

11. Device according to any of the preceding claims **characterized in that** it further includes a gasket (14) which, in the assembling conditions (M, MM) is interposed between the expansion box (110) and the flange (7) without interfering with the holes (6) and with the opening (12).

12. Device according to any of the preceding claims **characterized in that** the filtering elements first (2) and second (3) and the annular housings (8, 9) are mutually glued with bi-components synthetic resins.

13. Device according to any of the preceding claims **characterized in that** the filter (10) is external to the expansion box (110) in correspondence of the assembling condition (M).

14. Device according to any of the preceding claims **characterized in that** the filter (10) is almost totally contained inside the expansion box (110) in correspondence of a second assembling condition (MM).

Patentansprüche

1. Vorrichtung zum Filtrieren der Ansaugluft von Brennkraftmaschinen, die mit einem Expansionskasten (110) versehen sind, welcher eine Öffnung (12) hat, mit einem Filter (10), das ein erstes rohrförmiges Filterelement (2) umfasst und ferner aufweist:

- ein oberes ringförmiges Element (1), das aus einem ringförmigen Flansch mit L-förmigem Querschnitt besteht, welcher mit einem oberen ringförmigen Gehäuse (8) versehen ist, in dem das obere Ende des ersten Filterelementes (2) befestigt ist;
- ein zweites Filterelement (3), das umfangsmäßig an dem oberen Element (1) befestigt ist;
- Abstützmittel (4), die versehen sind mit einem unteren ringförmigen Gehäuse (9), in dem das untere Ende des ersten Filterelementes befestigt ist (2), einem zentralen Loch (5), das mit der Öffnung (12) entsprechend einem Montagezustand (M) in Strömungsverbindung steht, und einem ebenen Flansch (7) zum Befestigen des Expansionskastens (110).

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Abstützmittel (4) und das obere Element (1) aus einem Mehrkomponentenmaterial mit einer Kunststoffmatrix hergestellt sind, die mit Kohlenstofffasern verstärkt ist.

3. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Flansch (7) näherungsweise elliptisch oder kreisförmig oder polygonal geformt ist.
4. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Flansch (7) äußere Löcher (6) hat, in denen Befestigungsmittel (13) des Expansionskastens (110) entsprechend dem Montagezustand (M) sitzen.
5. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das zweite Filterelement (3) eben und näherungsweise kreisförmig ausgebildet ist.
6. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das zweite Filterelement (3) konkav oder konvex mit halbelliptischem Querschnitt ausgebildet ist.
7. Vorrichtung nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** das zweite Filterelement (3) eine Reihe von Sicken hat, die die Filterfläche und die Steifigkeit erhöhen.
8. Vorrichtung nach Anspruch 7, **dadurch gekennzeichnet, dass** die Sicken ringförmig und konzentrisch sind.
9. Vorrichtung nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** das zweite Filterelement (3) näherungsweise konisch geformt ist und eine Reihe von Sicken entlang seiner Erzeugenden hat.
10. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das erste und zweite Filterelement (2, 3) aus mehreren Baumwolllagen bestehen, die mit niedrigviskosem Öl getränkt und zwischen Netzelementen angeordnet sind.
11. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** sie ferner eine Dichtung (14) umfasst, die in den Montagezuständen (M, MM) zwischen dem Expansionskasten (110) und dem Flansch (7) angeordnet ist, ohne die Löcher (6) und die Öffnung (12) zu stören.
12. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das erste und zweite Filterelement (2, 3) und die ringförmigen Gehäuse (8, 9) mit Zweikomponenten-Kunstharzen miteinander verklebt sind.
13. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Filter (10) außerhalb des Expansionskastens (110)

entsprechend dem Montagezustand (M) angeordnet ist.

14. Vorrichtung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Filter (10) nahezu vollständig innerhalb des Expansionskastens (110) entsprechend einem zweiten Montagezustand (MM) untergebracht ist.

Revendications

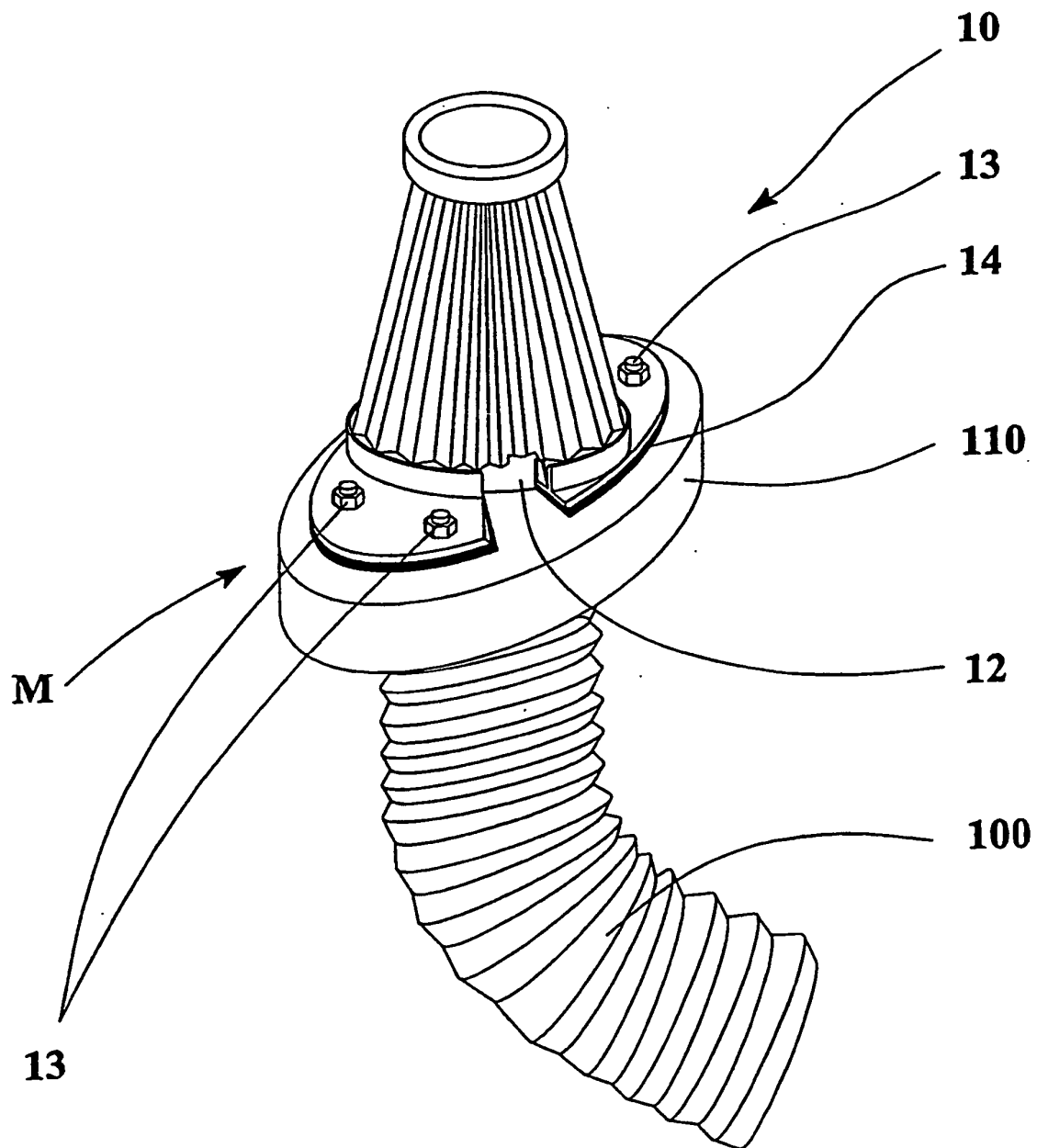
1. Dispositif pour filtrer l'air d'admission des moteurs à combustion interne doté d'une boîte d'expansion (110) ayant une ouverture (12), avec un filtre (10) comprenant un premier élément filtrant tubulaire (2) et comprenant en outre :
 - un élément annulaire supérieur (1) consistant en une bride annulaire à section en « L » doté d'un logement annulaire supérieur (8) dans lequel est fixée l'extrémité supérieure du premier élément filtrant (2) ;
 - un second élément filtrant (3) fixé périphériquement à l'élément supérieur (1) ;
 - des moyens d'appui (4) dotés d'un logement annulaire inférieur (9) dans lequel est fixée l'extrémité inférieure du premier élément filtrant (2), d'un trou central (5) en communication d'écoulement avec l'ouverture (12) en correspondance d'une condition d'assemblage (M) et d'une bride plate (7) pour fixer la boîte d'expansion (110).
2. Dispositif selon la revendication 1, **caractérisé en ce que** les moyens d'appui (4) et l'élément supérieur (1) sont faits en matériau composite avec une matrice synthétique renforcée par des fibres de carbone.
3. Dispositif selon la revendication 1, **caractérisé en ce que** la bride (7) a une forme approximativement elliptique ou circulaire ou polygonale.
4. Dispositif selon la revendication 1, **caractérisé en ce que** la bride (7) a des trous extérieurs (6) dans lesquels on engage des moyens de fixation (13) de la boîte d'expansion (110) en correspondance de ladite condition d'assemblage (M).
5. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le second élément filtrant (3) est plat et de forme approximativement circulaire.
6. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le second élément filtrant (3) est concave ou convexe,

avec une section semi-elliptique.

7. Dispositif selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** le second élément filtrant (3) a une série de gaufrages pour accroître la surface de filtrage et la rigidité. 5
8. Dispositif selon la revendication 7, **caractérisé en ce que** les gaufrages sont annulaires et concentriques. 10
9. Dispositif selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** le second élément filtrant (3) a une forme approximativement conique et une série de gaufrages le long de ses lignes génératrices. 15
10. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le premier élément filtrant (2) et le second élément filtrant (3) consistent en une pluralité de couches de coton, imbibées d'huile à faible viscosité et interposées entre des éléments en tulle. 20
11. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'il** comprend en outre un joint d'étanchéité (14) qui, dans les conditions d'assemblage (M, MM), est interposée entre la boîte d'expansion (110) et la bride (7) sans qu'il y ait interférence avec les trous (6) ni avec l'ouverture (12). 25 30
12. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le premier élément filtrant (2), le second élément filtrant (3) et les logements annulaires (8, 9) sont collés l'un à l'autre avec des résines synthétiques bi-composants. 35
13. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le filtre (10) est extérieur à la boîte d'expansion (110) en correspondance de la condition d'assemblage (M). 40
14. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le filtre (10) est presque entièrement contenu à l'intérieur de la boîte d'expansion (110) en correspondance d'une seconde condition d'assemblage (MM). 45 50

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FIG.1



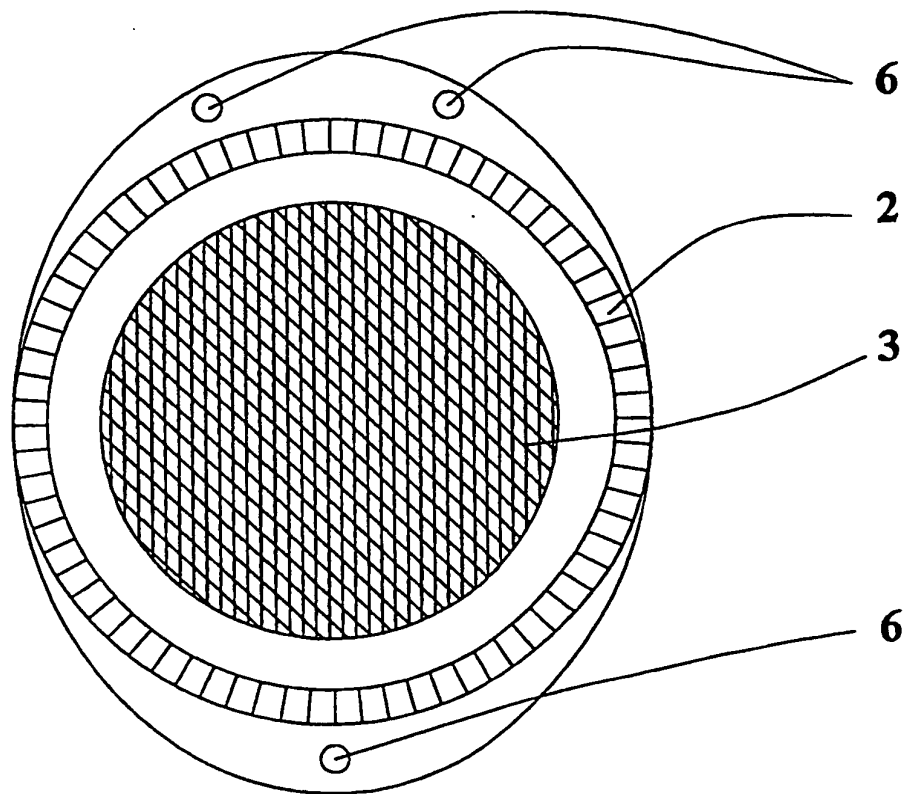
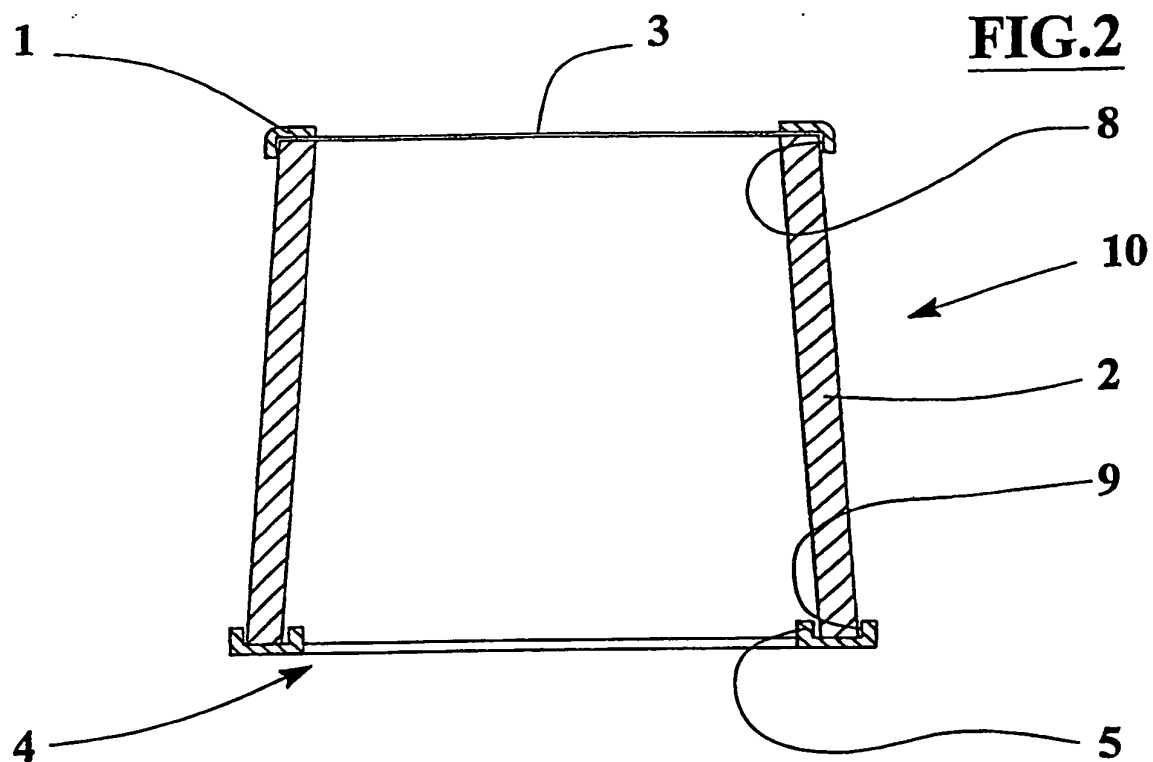


FIG.3

FIG.4

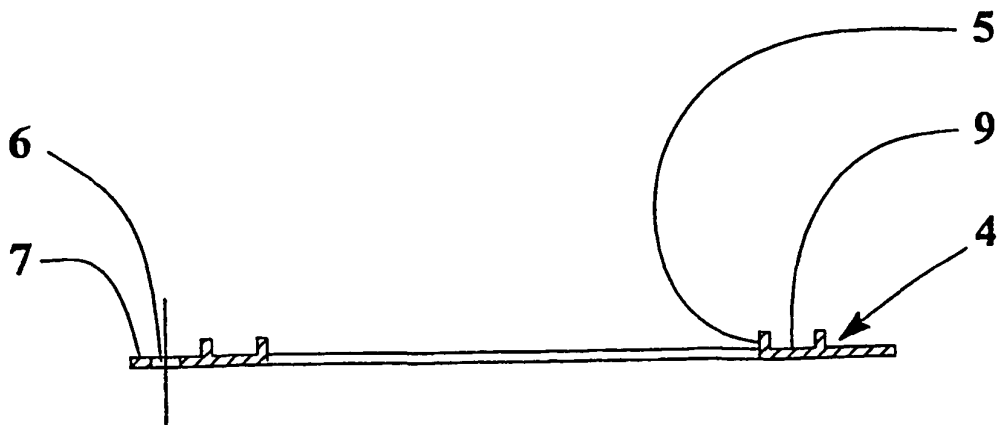
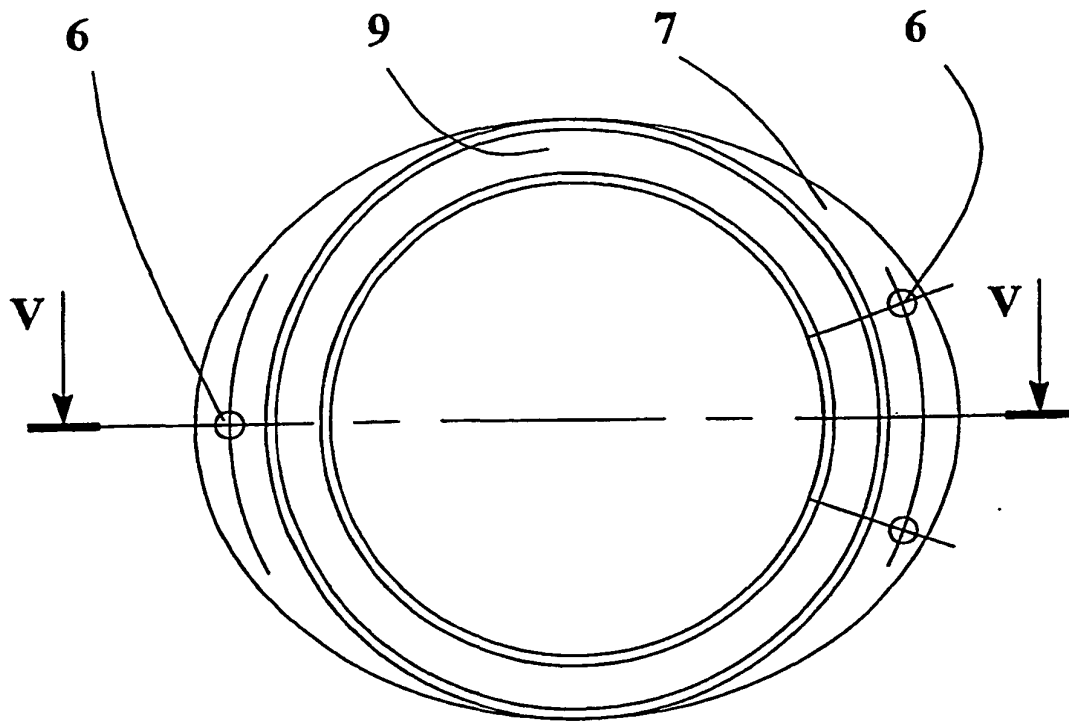


FIG.5

FIG.6

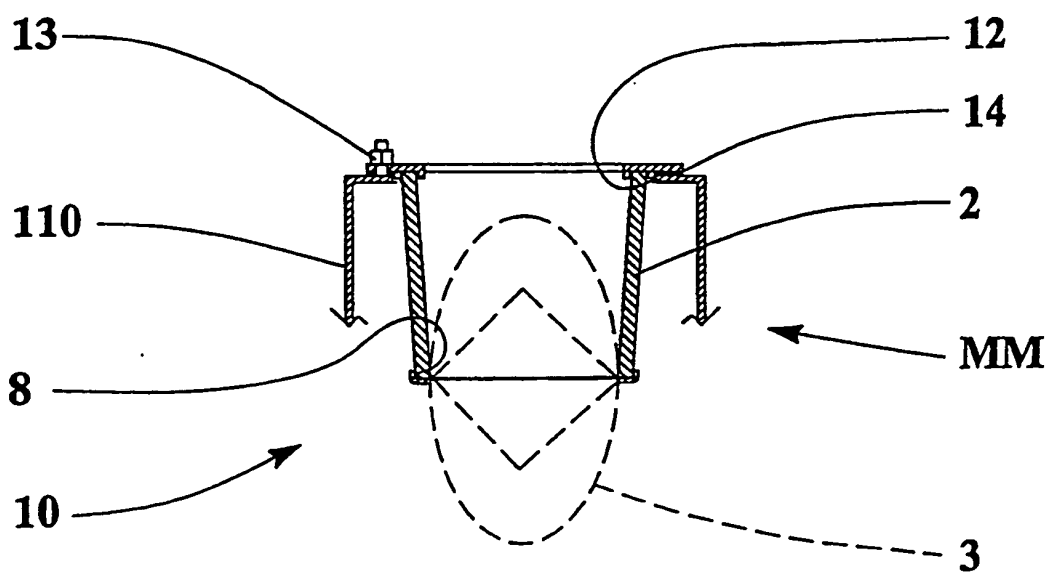
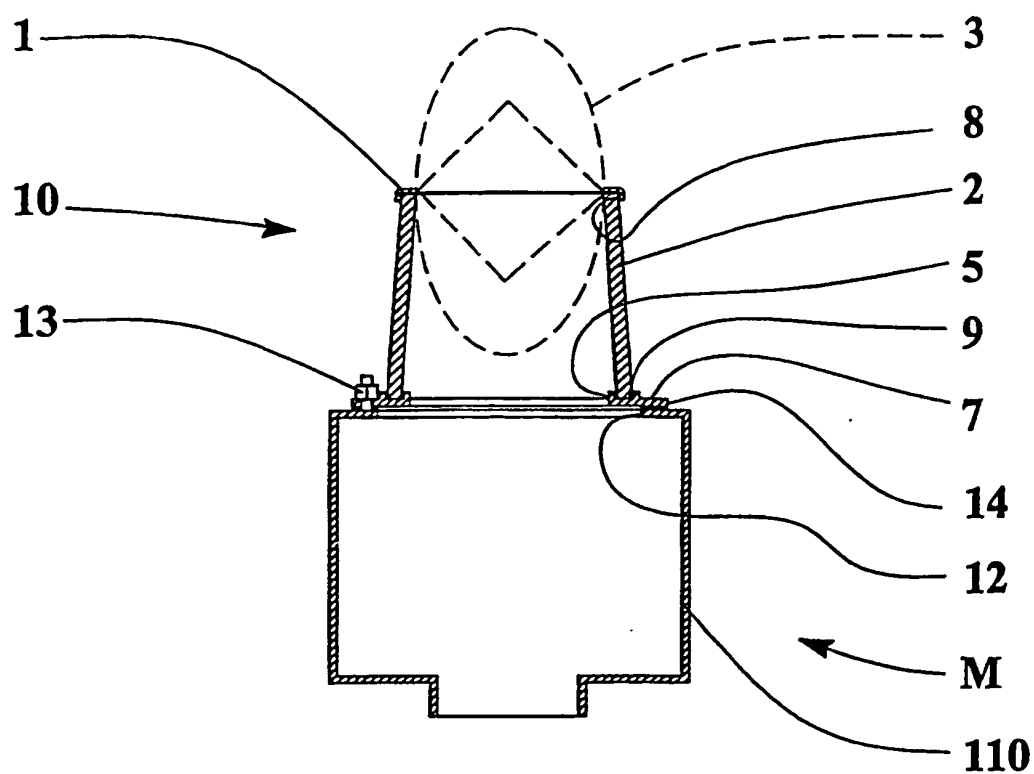


FIG.7